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An ex-post evaluation of the 2000-2006 Rural Development Plan of the Lazio Region using farm-level data

The paper evaluates the 2000-2006 Rural Development Plan of the Lazio Region. It applies a difference in difference analysis to a dataset composed of data from the V and VI agricultural census, and administrative data about rural development payments. The total sample is composed by 46,021 farms. The empirical analysis shows that farms receiving rural development payments (treatment) increased their competitive capability more than those with no payments (control group). The data supported the hypothesis of a selection effect: farms with higher competitive capability were more likely to obtain payments. A regression approach confirmed the results of the non-parametric difference in difference analysis.

1. Introduction

The quantitative evaluation of rural development programs is an open question for academics and policy makers (Bradley et al. 2010). A recent report by the European Court of Auditors (Special Report 12, 2013) questioned the effectiveness of the public intervention and concluded that the current monitoring indicator data on results are not reliable enough to prove that that the "EU budget allocated for rural development policy are well spent". Recent literature supported the conclusion that more work is needed for an evidence-based and result driven agricultural and rural development policy (Hodge and Midmore 2008; Shaxon 2011).

This paper presents an empirical evaluation of the 2000-2006 Rural development plan in the Lazio Region using farm-level data. The micro-economic from the V and VI Agricultural Censuses have been linked to an administrative dataset of the rural development payments. The resulting informative base allowed us to assess the impact of payments at individual level and then use a «difference in difference analysis». A regression approach is used to confirm the results from the non-parametric estimation.

The micro-economic approach to policy evaluation is well known in the literature (Buysse et al. 2011). The contribution of this paper lies in the unique

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panel data from two censuses (2000 and 2010) and in the original performance indicator, based on the analysis of the emergent strategy of individual farms (Russo and Sabbatini 2005, Sabbatini 2008).

The objective of the analysis is to assess if the rural development payments do achieve a statistically significant impact on the strategic positioning of Lazio farms and in describing such impact.

2. Methodology

The paper applies a 'difference in difference analysis' to a panel of 46.021 farms from the Lazio region. The dataset is composed of data from the V and VI agricultural censuses and from the administrative archives of rural development payments from the 2000-2006 Rural Development Plan.[1] The study sample is defined by the intersection set of the two censuses: a deterministic match identified the farmers that are in both datasets. The sample represents the 47,6% of the number of farms in the 2010 Census. The sample is not representative because it excludes all farms that for whatever reasons were registered under different farmer names. Those exceptions may include relevant cases (such as farm transmission and generation turnover) or simply collection errors. Although the sample is not representative, the sheer size of it allows us to draw conclusions of general interest. Table 1 summarizes descriptive statistics of the sample.

The difference in difference analysis compares the variation in a set of performance indicators between two groups: one is subjected to a *treatment* (the study group) and the other one is not (the control group) (e.g., Cook and Campbell 1979, Meyers 1995). To the purpose of this paper, the treatment is the receiving of a rural development payment. The performance indicators are the *Index of competitive capability* (ICC) and the *Index of interaction with the external environment* (IIE). The two indicators are obtained from the classification algorithm of the strategic typology by Russo and Sabbatini (2005) and are calculated from the factor scores obtained from an iterated multiple correspondence analysis (MCA). The Authors used MCA and cluster analysis to define strategy profiles of Italian agricultural farms. The MCA factors obtained in the process can be used as coordinates to place farms in a 'strategy space' and measure the distance of each observation from the profile centroids. The location of the observation in the strategy space can be used to characterized and describe the farm strategy through the relative distance from each centroid. Such description is defined as the farm's strategic positioning.

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[1] The data are courtesy of the Department of Agriculture of the Lazio Region, which provided an anonymous dataset based our specifications.

Tab. 1. Descriptive statistics

Provincia		Farms (n.)	UAA 2000 (ha)	UAA 2010 (ha)	Avg. age (years)	Female farm. (%)	Ax. 1 benef. (%)	Ax. 2 benef. (%)	Ax. 3 benef. (%)
Viterbo	Mount.	-							
	Hills	9.861	7,0	7,7	64	28,9	3,1	0,5	13,2
	Plains	1.046	15,1	16,6	63	20,7	4,2	0,3	6,6
Rieti	Mount.	1.579	7,2	9,8	64	28,8	9,9	1,5	9,1
	Hills	2.862	3,5	3,5	65	27,0	3,0	0,5	11,8
	Plains	-							
Roma	Mount.	993	4,3	5,6	66	25,3	2,4	0,1	2,9
	Hills	7.202	4,0	4,2	64	27,8	3,5	0,3	6,1
	Plains	949	14,7	12,8	63	22,3	7,3	0,5	8,1
Latina	Mount.	343	1,1	2,2	62	31,8	0,9	0,0	0,0
	Hills	4.596	2,2	2,4	63	28,5	1,7	0,0	1,4
	Plains	4.529	3,9	4,2	59	26,8	8,1	0,2	2,1
Frosinone	Mount.	3.975	2,0	2,8	64	31,9	1,6	0,1	3,0
	Hills	8.086	2,9	3,0	64	38,4	1,9	0,1	2,5
	Plains	-							
Lazio	Total	46.021	4,6	5,1	64	29,9	3,5	0,3	6,3

The MCA factors of the strategic typology are defined by linear combination of census variables, which can be interpreted as the 'underlying socio-economic drivers' of farms' emergent strategies (Russo, Sabbatini 2005). The interpretation of the MCA factors allows the researchers to describe the strategic positioning using economic concepts. The first MCA factor is the ICC and it is associated with farm's economic and physical size, market orientation and human capital. Farms with high values of ICC, on average, exhibit higher capital investment (both in farmland, livestock and mechanization), market a higher percentage of total production (self-consumption is marginal) and have better education. The farms with high values of ICC are not necessarily more competitive, but on average are expected to be more likely to face competition. Such expectation is driven by the assumption that, in equilibrium, large financial investments in market-oriented firms are rational only if the farm is able to withstand competition. The IIE is obtained from the second factor, which is associated with high level of relational goods, the adoption of PDO or PGI

label, cooperative membership and off-farm employment. Farms with high values of IIE build value from the interaction with the external social and economic environment. Farms with low values of IIE focus on on-farm operations. The combination of the ICC and IIE defines the farm strategic positioning. Table 2 reports mean values of the ICC and IIE by province.

Tab. 2. Mean values of ICC and IIE

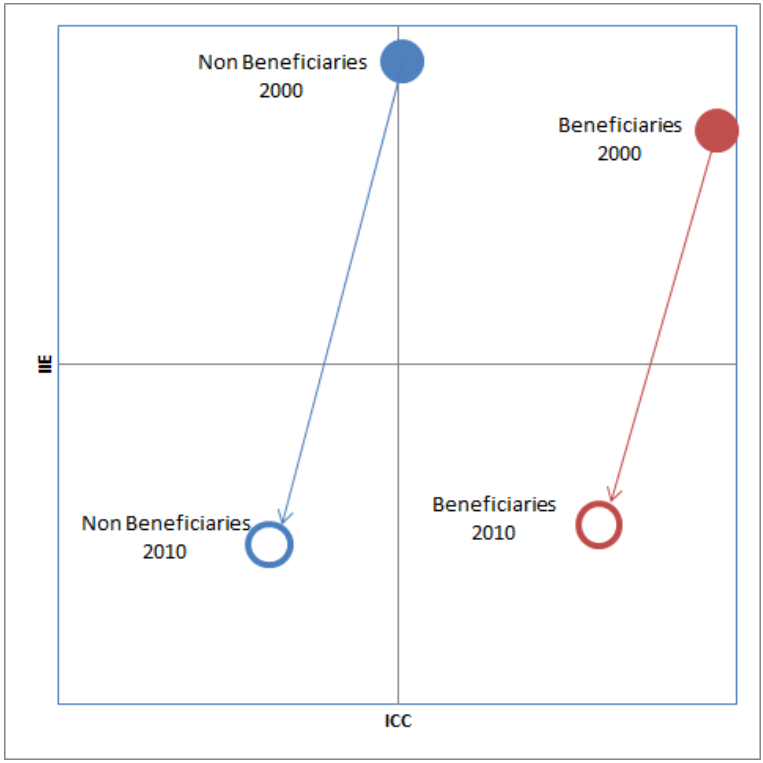
Provincia		ICC 2000	ICC 2010	Var. ICC	IIE 2000	IIE 2010	var. IIE
Viterbo	Mount.						
	Hills	0,139	-0,142	-0,281	0,170	-0,040	-0,210
	Plains	0,565	0,041	-0,524	0,280	-0,167	-0,447
Rieti	Mount.	0,191	0,021	-0,171	-0,062	-0,176	-0,114
	Hills	0,070	-0,268	-0,338	0,158	-0,001	-0,159
	Plains						
Roma	Mount.	-0,162	-0,303	-0,141	0,102	-0,088	-0,190
	Hills	0,001	-0,297	-0,298	0,174	-0,058	-0,231
	Plains	0,472	0,077	-0,395	-0,047	-0,285	-0,238
Latina	Mount.	-0,354	-0,416	-0,062	0,239	0,004	-0,235
	Hills	-0,031	-0,392	-0,361	0,260	0,011	-0,250
	Plains	0,331	0,034	-0,297	0,082	-0,150	-0,231
Frosinone	Mount.	-0,227	-0,460	-0,234	0,129	-0,069	-0,199
	Hills	0,042	-0,336	-0,378	0,036	-0,136	-0,171
	Plains						
Lazio		0,074	-0,234	-0,309	0,132	-0,079	-0,211

Obviously, ICC and IIE do not capture the full scope of the second pillar of the CAP. Rural development policies pursue a broad set of objectives including environmental preservation, social inclusion, identity preservation and many others. Such general goals are not measured by changes in the strategic positioning, because the metric is focused on the individual farm without considering the systemic effects of the policy. Nevertheless, the impact of Rural Development Payments on competitiveness and economic integration is still an interesting study question, because such objectives were mentioned explicitly in the Lazio Rural Development Plan 2000-2006 (p. 21 of the document).

Consequently, this analysis cannot be considered as an encompassing evaluation of the effectiveness of rural development policies. It is an assessment of how such policies can impact farms' strategies and change them in a direction that is compatible with public objectives.

Comparing individual data from the 2000 and 2010 censuses it is possible to measure the difference in the values of the performance indicators IIC and IIE before and after receiving rural development payments (treatment).[2] The variations in the values of the farms that did not obtain payments are used as

Fig. 1. Strategic positioning of farm receiving rural development payments (beneficiaries) and farm not receiving rural development payments (non beneficiaries) in 2000 and 2010



[2] Clearly, the comparison between two censuses may reflect factors that are specific of one of the two points in time. Nevertheless, the use of short panels is a common approach in the literature due to data availability.

counterfactual (control group). Such difference in difference analysis allows us to measure the impact of rural development policies on farmers' strategic positioning. Figure 1 illustrates the structure of the analysis. The diagram represents a two-dimension strategy space where the two axes are the ICC and the IIE. The position of each observation in the strategy space defines the strategic positioning of the farm. In the diagram, four groups are placed in the strategy space: the treatment group (i.e., farmers who received rural development payments, the 'beneficiaries') and the control group (i.e., farmers who did not receive payments, the 'non beneficiaries) before the treatment (in year 2000) and after the treatment (year 2010). The coordinates of the four points were calculated using the average of IIC and IIE for each group. The difference in difference analysis tests if the change in the strategic positioning after treatment is statistically significant.

3. Results

The explorative analysis of the data set suggests a possible association between the value of the ICC *before the treatment* and the probability of receiving rural development payments. Figure 1, in fact, shows that beneficiaries exhibited, on average, a much higher value of ICC in year 2000. For a more detailed analysis, Figure 2 reports histograms representing the relative frequencies of beneficiaries and non-beneficiaries by class of ICC values in year 2000. In order to get a differentiation among the different measures in the rural development plan, the payments have been broken down according to the three axes of Lazio 2000-2006 program: efficiency (axis 1), diversification (axis 2) and agro-environmental payments (axis 3). The graphs suggest that the distribution of the two groups is different.[3]

A formal t-test on the average ICC values of the two groups allows us to reject the null hypothesis of equality of the means at 99% confidence level.[4] This outcome has major implications. It suggests that farms with higher competitive capability might have easier access to rural development policy. Furthermore, it implies that the distribution between the control and treatment groups might not be random.

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[3] This classification was obtained from the official RD plan by Regione Lazio, available at http://www.agricoltura.regione.lazio.it/agriweb/schede_informative_dettaglio.php?id=69&idat=27 . Note that in 2000-2006 agri-environmental payments were included in Axis 3 (p.82 of the document), unlike 2007-2013 plan where they were placed in Axis 2.

[4] The t statistic for the test on Axis 1 was t(46019) = 59,361, for Axis 2 was t(46019) = 16,862, for Axis 3 was t(46019) =8,413

Fig. 2. Sample distribution by values of ICC: Beneficiaries and Non-beneficiaries (Relative frequencies, year 2000)

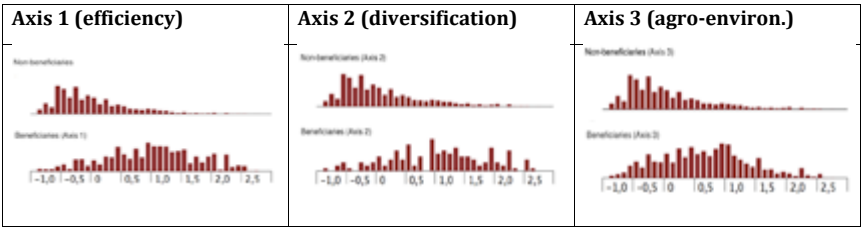
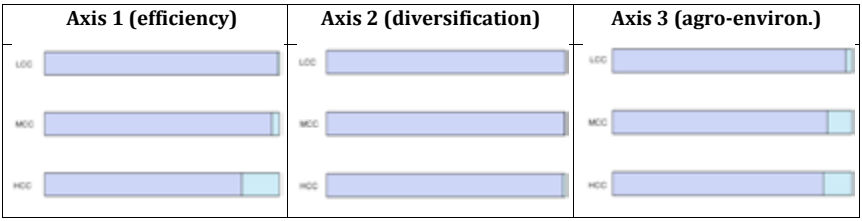


Fig. 3. Relative frequencies of beneficiaries and non-benefeciaries by ICC class (year 2000)



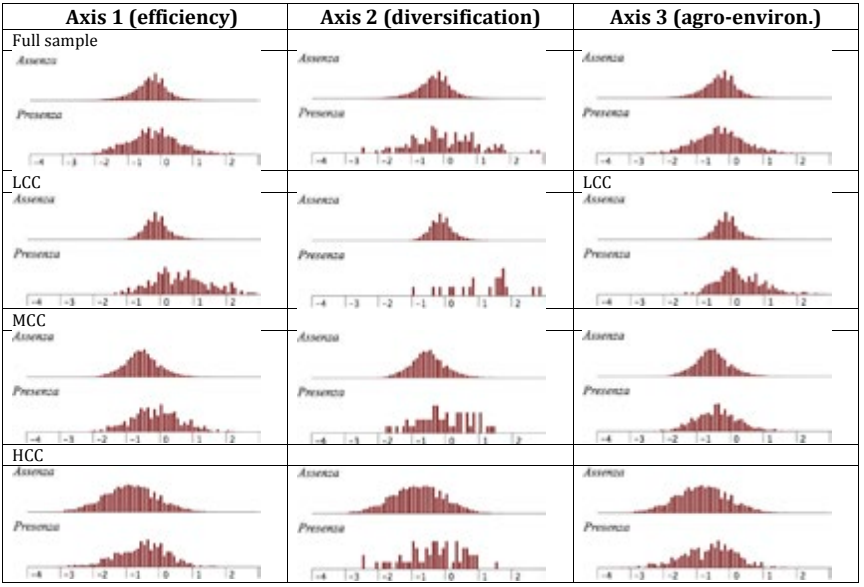
For controlling the endogenous selection, the sample was broken down into three classes based on the value of the ICC: low, medium and high competitive capability denoted as LCC, MCC and HCC respectively (Russo and Sabbatini 2005). Figure 3 reports the relative frequencies of beneficiaries and non-beneficiaries for each ICC class. A χ^2 test allows us to reject the null hypothesis of absence of association between the two variables.[5]

The association between the value of IIE at 2000 and the access to rural development payments is not supported by empirical evidence at 99% confidence level. Only in the case of Axis 1, the beneficiaries showed a significantly lower average value of IIE. These results suggest that it is advisable to control for the starting values of the ICC when testing for association between rural development payments and changes in the strategic positioning, while controlling for the initial values of IIE is not necessary.

Figure 4 reports the distribution of the relative frequencies of beneficiaries and non-beneficiaries by class of variation of ICC (2010 with respect to 2000) and ICC class. The empirical analysis supports the assumption that rural de-

[5] The $\chi^2(2)$ statistics for the three cases are 3.013,8; 175,3 and 1.321,823 for Axes 1, 2 and 3 respectively.

Fig. 4. Relative frequencies of beneficiaries and non-beneficiaries by class of variation of ICC and class of ICC (2000)



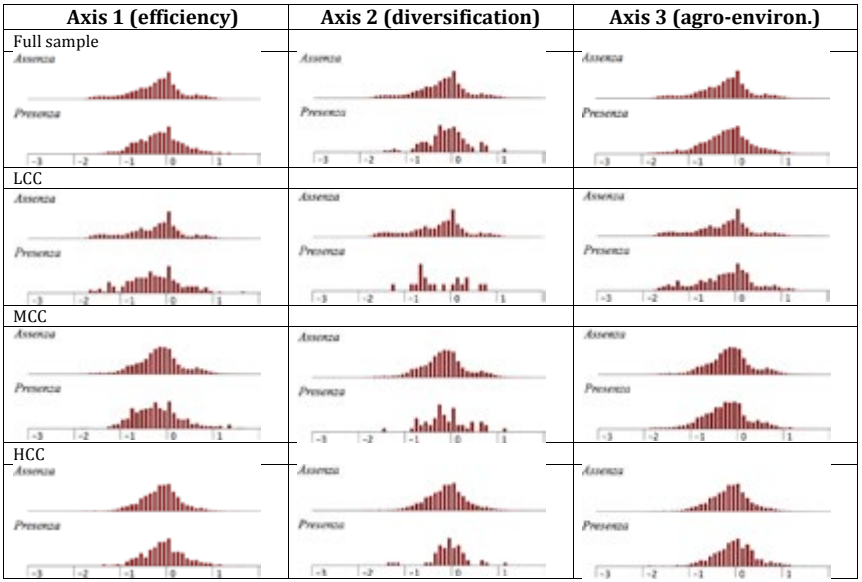
velopment payments have – on average – a positive effect on the competitive capability of farms. Between year 2000 and 2010, the average ICC value decreased by 0.312 for the non-beneficiaries and by 0.221 for the beneficiaries. The difference is statistically significant at 99% confidence level. Rural development payments are associated with a slower decline of the competitive capability, compared to the national trend.[6]

The effects of rural development payments on the IIE are more ambiguous. Figure 5 illustrates the distribution of the variations in IIE for beneficiaries and non-beneficiaries. The data allow us to reject at 99% confidence level the null hypothesis of equality of means between the two groups only as far as Axis 1 is concerned. When Axes 2 and 3 are considered, the differences in mean values are not statistically significant.

Sample segmentation according to ICC classes confirms the ambiguous results. The effect of rural development payments on the IIE mean value of LCC

[6] By construction, the ICC is normalized with respect to the Italian average in each year. Consequently, a negative variation over time can be interpreted as a decline of the relative competitive capability with respect to the mean.

Fig. 5. Relative frequencies of beneficiaries and non-beneficiaries by class of variation of IIE and class of ICC (2000)



farms is not statistically significant for any Axes. The mean IIE value of MCC farms is significantly lower when they receive payments from Axes 3 (the t statistic is 5,614) and it is not significantly different for Axis 1 and 2. Rural development payments from Axes 1 and 3 have a significant and positive effect on the IIE of HCC farms. Axis 2 payments are not associated with any significant effect on mean values. Table 3 summarizes the test results.

4. A regression approach

The difference in difference analysis is a non-parametric approach that does not rely on distributional assumptions about variables. However, it fails to control for covariates that can explain the underlying economic behavior. Reduced-form regressions can provide additional insight into the effects of rural development payments on farms' strategic positioning and into the determinants of policy access. Table 4 reports the results from a probit estimation of the conditional probability of obtaining a rural development payment. The dependent variable Policy is a dummy equal to 0 if the farm did not obtain any payment and 1 otherwise.

Tab. 3. Summary results of the t-tests comparing the mean values of variations of ICC and IIE (2000-2010) of beneficiaries (μB) and non-beneficiaries (μNB)*

	Axis 1	Axis 2	Axis 3
LCC	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB
MCC	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: reject H0, μB>μNB IIE: reject H0, μB<μNB
HCC	ICC: reject H0, μB>μNB IIE: reject H0, μB>μNB	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: reject H0, μB>μNB IIE: reject H0, μB>μNB
Total sample	ICC: reject H0, μB>μNB IIE: reject H0, μB>μNB	ICC: reject H0, μB>μNB IIE: fail to reject H0, μB=μNB	ICC: fail to reject H0, μB=μNB IIE: fail to reject H0, μB=μNB

** The null hypothesis H0 is equality of the mean values. The confidence level is 99%*

The probit regression confirms the selection issue. Firms with higher ICC in 2000 were more likely to have access to rural development payments. The value of IIE at 2000 is negatively associated with the dependent variable – after controlling for the effects of all other variables – although the marginal probability is remarkably lower than the one from ICC.

The regression results are consistent with expectations: young and educated farmers are more likely to obtain payments. Gender is not significant. Spatial distribution can explain the probability of access: farms located in mountain areas (where Axis 3 had special programs) and in the northern part of the region (where extension services are more effective) are more likely to receive payments.

The results suggest that the access to the policy required a non-negligible level of human capital and efficient support and services. Such barriers can explain partially the low rate of access to payments.

Table 5 reports the results of reduced-form regressions of the variations in ICC and IIE on a set of explanatory variables including: dummy variables identifying the beneficiaries of payments (Axis 1, 2 and 3), the initial strategic positioning (the values of ICC and IIE at year 2000), demographic variables (age, gender and education) and a set of dummy variables describing the spatial location of the farm (province and altitude). To account for possible heteroschedasticity, White robust standard errors were computed.

The regression results support the hypothesis that rural development payments increase the competitive capability of Lazio farms: the coefficients as-

Tab. 4. Probit estimation of the conditional probability of obtaining a rural development payment

	Dep. variable: Policy (being beneficiary of a payment of any kind) Likelihood Ratio Test: 5889.94 p.val.: 0.0000			
	Coeff.	Std. Error	T-ratio	Marg. Prob.
ICC_2000	0.686	0.014	50.486	0.071
IIE_2000	-0.138	0.020	-6.825	-0.014
VT	0.626	0.030	20.705	0.065
RI	0.617	0.035	17.598	0.064
RM	0.307	0.033	9.407	0.032
LT	0.018	0.039	0.474	0.002
Gender	0.035	0.021	1.647	0.004
Age	-0.017	0.001	-17.755	-0.002
Mountains	0.067	0.033	2.064	0.007
Plains	-0.063	0.031	-2.011	-0.007
Bachelor degree	0.786	0.081	9.690	0.082
High school	0.477	0.074	6.479	0.050
Middle school	0.227	0.073	3.132	0.024
Elementary school	0.048	0.071	0.675	0.005
Constant	-1.079	0.101	-10.641	

sociated to the three dummy variables Axis 1, 2 and 3 are significant and positive. As expected the payments from Axis 3 have a smaller coefficients, because agri-environmental payments did not require (or finance) new on-farm investments or change in the business strategy. On average, after controlling for all other variables, payments from Axis 1 reduce the expected value of the IIE. The impact of the other Axes is not significant. The negative coefficient suggests that payments from Axis 1 – on average and keeping everything else constant – are expected to reduce the degree of integration with the external economic environment. The result can be explained by the very nature of the measures. They supported on-farm investments (such as innovation or processing plants) or provided incentives to full-time farming and labor specialization (supporting generation turnover or life-long learning). Consequently, the farmers receiving payments have incentive to focus on on-farm operations and reduce off-farm employment, reducing the expected IIE.

Tab. 5. Regression of variations in ICC (ΔICC) and IIE (ΔIIE) on a vector of explanatory variables

	dep. variable: ΔICC adj. R2: .4281 F-stat: 2027.6 p.val: 0.000				dep. variable_ ΔIIE adj. R2: .4754 F-stat: 2453.9 p.val:0.000			
	coefficient	robust std. error	t-stat	p.val.	coefficient	robust std. error	t-stat	p.val.
Axis 1	0.437	0.019	23.560	0.000	-0.176	0.011	-16.360	0.000
Axis 2	0.430	0.067	6.416	0.000	-0.073	0.031	-2.363	0.018
Axis 3	0.281	0.012	23.270	0.000	-0.004	0.008	-0.507	0.612
ICC_2000	-0.635	0.005	-137.900	0.000	-0.072	0.003	-23.540	0.000
IIE_2000	-0.092	0.004	-21.300	0.000	-0.813	0.005	-179.200	0.000
Gender	-0.068	0.005	-14.910	0.000	-0.005	0.004	-1.123	0.261
Age	-0.010	0.000	-37.720	0.000	-0.016	0.000	-69.850	0.000
Mountain	0.044	0.006	7.613	0.000	-0.013	0.006	-2.101	0.036
Plains	0.151	0.008	18.080	0.000	-0.149	0.006	-24.120	0.000
Bachelor Degree	0.039	0.015	2.589	0.010	0.119	0.015	7.854	0.000
High School	0.015	0.011	1.317	0.188	0.093	0.010	8.866	0.000
Middle School	0.025	0.010	2.414	0.016	0.016	0.010	1.628	0.104
Elementary School	0.014	0.009	1.470	0.142	-0.039	0.009	-4.495	0.000
VT	0.140	0.006	22.480	0.000	0.066	0.006	10.990	0.000
RI	0.114	0.008	14.310	0.000	0.073	0.007	9.751	0.000
RM	0.067	0.006	10.900	0.000	0.028	0.006	4.694	0.000
LT	0.030	0.007	4.414	0.000	0.065	0.007	9.671	0.000
Constant	0.254	0.022	11.630	0.000	0.925	0.020	46.980	0.000

Axes 2 and 3 do not exhibit such direct correlation and the effects on IIE are not significant.

The coefficients of the socio-demographic variables are consistent with expectations. Young farmers are expected to achieve better performance in terms of ICC and IIE compared to old farmers. Education is positively associated with the variations of ICC and negatively associated to changes in IIE (because educated farmers have a higher reservation salary and are more keen to off-farm employment). Gender exhibits a negative correlation with variation of ICC but has no significant impact in IIE.

Compared with the difference in difference approach, the regression approach requires stronger assumptions about error terms and functional forms. Consequently, the results can suffer of a misspecification bias. Nevertheless, regressions consider explicitly a set of covariates allowing the researcher to control for exogenous determinants, unlike the non-parametric difference in difference form section 3. The results of the two approaches are consistent: they both show a selection problem and support the hypothesis that rural development payments have a positive impact on the ICC. The effects on IIE are less clear.

5. Conclusions

The analysis concludes that the 2000-2006 rural development policies of Lazio region had a significant impact and contributed to improve competitive capability. Beneficiaries achieved on average larger (or less negative) increments of ICC than non-beneficiaries with similar characteristics. Yet, critical issues emerged. The data suggested a selection effect: farmers with higher ICC in 2000 were more likely to benefit from payments, especially from axis 1. This confirms the well-known result paradox: farmers who "need less" public supports are more likely to obtain it. Moreover, the access barrier for the least competitive farms has indicated that the rural development policy was more effective in favoring and strengthening the strategies of already competitive farms rather than helping inefficient producers to invest in competitive capacity.

Noticeably, the estimated effect on the ICC of payments from Axis 3 is significantly lower than the other two Axes. This result is consistent with expectations, because agro-environmental payments did not require farmers to adopt business-development plans.

The effect of rural development payments on the IIE is ambiguous. The econometric model suggests that after controlling for starting conditions, demographics and spatial location, Axes 2 and 3 have no significant effect. The overall net effect of the payments from Axis 1 is negative, meaning that such transfers might give incentives to business model that are focused on on-farm operations. Only the HCC group showed the ability of using payments to develop integrated business models.

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